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Biological Effects of Radiation Damage in Plants

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Objectives:

- Analyze the genetic effects of radiation in plants.
- Describe changes in phenotype as a result of radiation damage.
- Discuss how radiation could cause the observed effects?

Research Question:

Will irradiation affect plant growth or morphology? How much does the level of irradiation affect the plants?

Discussion Questions:

1. What percentage of each irradiated group germinated for the plants you observed? What is the average germination rate for each irradiated group for the entire class? Is the difference in the average germination rate between each irradiated group and the control group statistically significant?
2. What was the average height of the plants in each irradiated group when the first flower was observed? Is the average the same for each irradiated group for the entire class? Is the difference in the average height between each irradiated group and the control group statistically significant?
3. What was the average number of seedpods that were present for each irradiated group for the plants you observed? Is the average the same for each irradiated group for the entire class? Is the difference in the number of seedpods between each irradiated group and the control group statistically significant?
4. What was the average number of seeds in each seedpod for each irradiated group for the plants you observed? Is the average the same for each irradiated group for the entire class? Is the difference in the average number of seeds within the seedpods between each irradiated group and the control group statistically significant?
5. How could you use the DNA of radiated and non-radiated plants to determine if there were genetic effects?
6. Were all effects negative? Why? Can you observe all effects? Why or why not? What do you think the effects on the next generation(s) will be?

Materials:

1. Irradiated Seed Set of desired type (*Brassica rapa*, *Arabidopsis*, radish, chrysanthemums, etc. You will need to obtain them from a vendor).
2. Record book to record data.
3. Camera to record data, if desired.

Example: Plant Images:

The following images are the growth results of seed that were planted after having been exposed to radiation (or no radiation, in the case of the control).



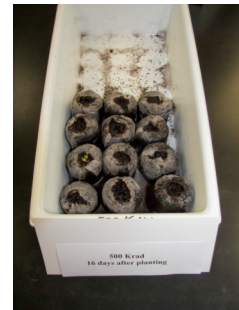
Control
16 days



50 Krad
16 days



150 Krad
16 days



500 Krad
16 days

Directions:

The exact protocol for this experiment will depend upon which vendor and specimen is chosen. For this experiment, plant the pre-irradiated seeds following the directions provided with the seed. Record the number of seeds planted and the date.

1. Observe and record each day the germination rate and rate of emergence and appearance of the seedlings of the control and irradiated types.
2. After the recommended time for germination of the plants (on day 5 for *Brassica*) record the total number of seedlings. Calculate the percentage of germination and the percentage of emergence. Record the appearance and height of the seedlings.
3. Each day record height, number of leaves, the general appearance of all plants, total height when the flower first opens, and date of the first flower. As necessary, stake up the plants. Tape 5" x 8" paper cards between the irradiated and control plants to provide a barrier and prevent accidental pollination between groups.
4. At the recommended time (day 14 to 18 for *Brassica*), use a bee-stick or a clean Q-tip to place pollen from one control plant onto another control plant's flowers. Record the date of pollination.
5. Use a bee-stick or a clean Q-tip to place pollen from one irradiated plant onto another irradiated plant's flowers. Record the date of pollination.
6. At intervals after pollination (up to about day 40 for *Brassica*), make frequent observations and record height, number of leaves, and number of seedpods.
7. At the recommended time (between day 41 to 45 for *Brassica*) harvest seedpods and count seeds found within the pods. Record number of seeds and calculate the average number of seeds per pod.

(**Note:** Equipment and materials for this activity are also commercially available from various educational resources.)

References:

Brassica rapa: <http://www.fastplants.org/>
<http://www.hps.org/publicinformation/ate/q1280.html>